ECOSYSTEM STATUS INDICATORS
Physical Environment

GULF OF ALASKA
Gulf of Alaska Survey Bottom Temperature Analysis
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Groundfish assessment surveys in the Gulf of Alaska have been conducted every two or three years since 1984 between Islands of Four Mountains (170°W) and Dixon Entrance (132°30'W) at depths between 15 and 1000 m. The area and timing of the surveys have been inconsistent from year to year. The maximum depth of sampling has also varied between 1000 m (1984, 1987, 1999, 2005), 750 m (2003) and 500 m (1990, 1993, 1996, 2001). These inter-annual differences complicate the comparison of bottom temperature data and require that the analysis consider date and location for the results to be meaningful. The method of temperature data collection has also changed over time. Prior to 1993, bottom temperature data were collected with expendable bathythermographs (XBTs) when available, usually after completion of the survey trawl for fish. Since 1993, data have been collected using micro-bathythermographs (MBTs) attached to the headrope of the trawl during each tow.

To examine inter-annual bottom temperature differences, data were binned into depth ranges (< 50, 51-100, 101-150, 151-200, 201-300, 301-400, 401-500, 501-700 and 701-1000 m). For each depth stratum, a generalized additive model was constructed with the form:

Bottom Temperature = loess (Julian Date) + loess (Latitude, Longitude)

Each survey year's data was given equal weight in the analysis to account for different sample sizes between years. The mean and standard error of the residuals were then calculated by year to examine inter-annual differences in bottom temperature. Figure 15 shows the results plotted by depth with year on the x axis, while Figure 16 presents the same information by year with depth plotted on the x axis. Values appearing above the horizontal line can be considered as being warmer than normal and those below, cooler.

The data indicate that water temperatures in 1984, 1987, 2001 and 2003 were above normal for this period with 1984 and 2003 representing the warmest years of the period for all depths combined. Temperatures during the 2003 survey were the warmest yet recorded in depths less than 150 m. Temperatures were also quite warm in 1984 between 151 and 200 meters, with unusually cool temperatures in the shallowest waters, similar to the pattern seen in 1987. Temperatures throughout the 1990s appear to have been generally cooler than normal, with 1999 being the coolest year. At water depths between 51 and 150 meters the coolest years were in 1990 and 1999. Perhaps the most notable result is the general warming pattern in depths less than 50 meters over the entire time series (Figure 15). Bottom temperatures appeared to be near normal in 2005 with the notable exception of the large positive anomaly at depths less than 50 m.

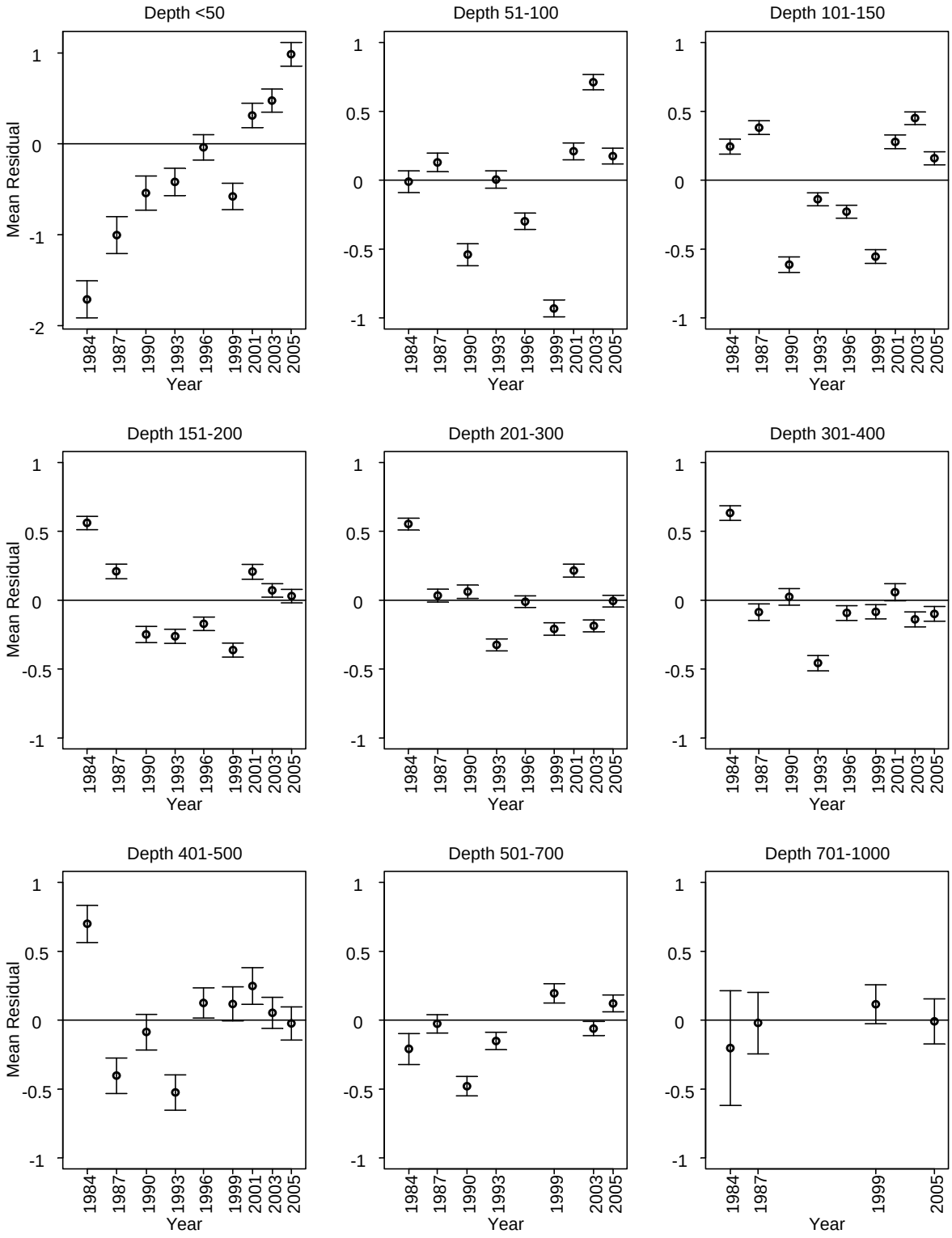

Figure 15. Mean temperature anomalies plotted by year within each depth stratum. Error bars are standard errors. Note expanded scale in < 50 m plot.

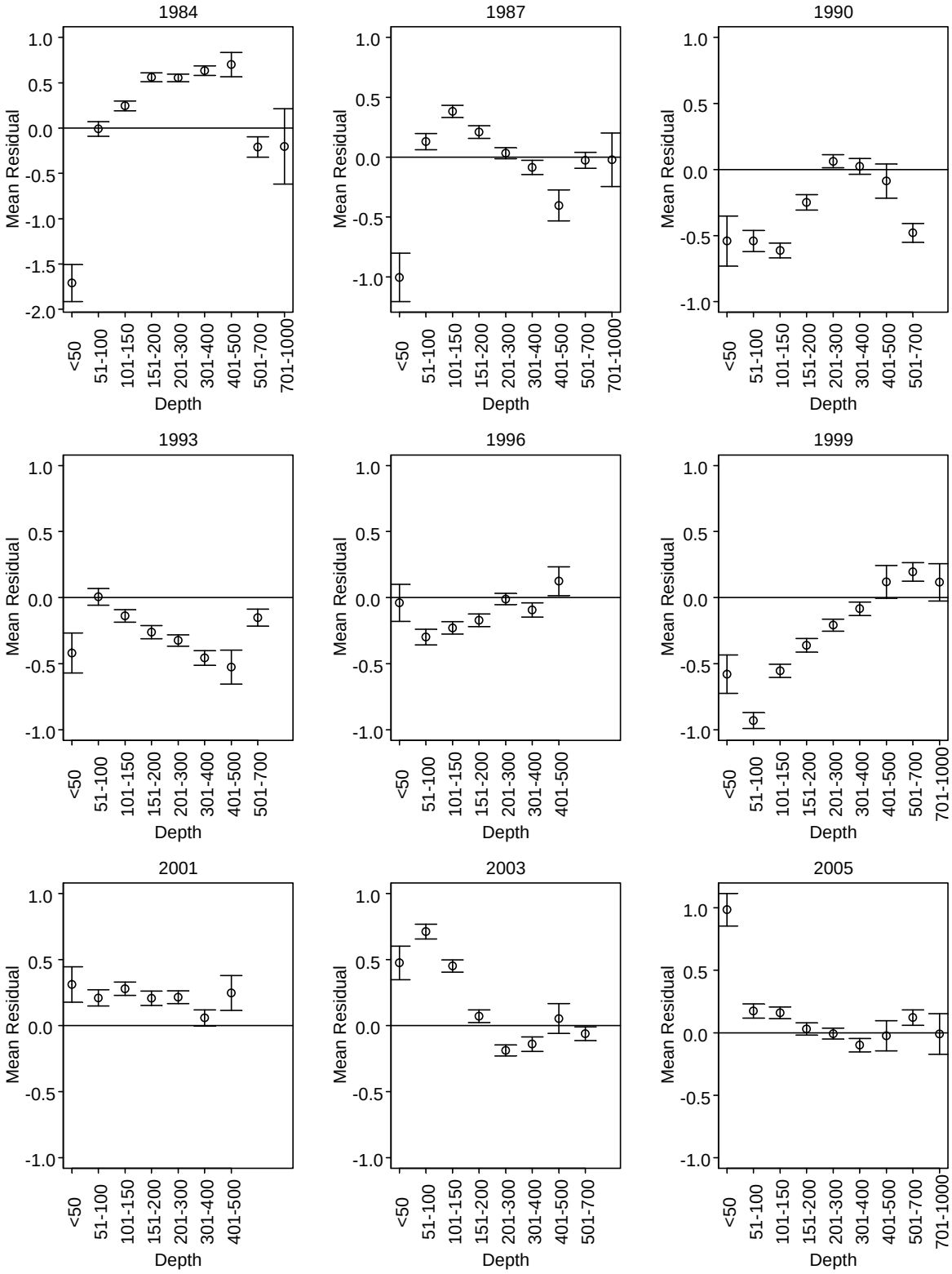

Figure 16. Mean temperature anomalies plotted by depth stratum within each year. Error bars are standard errors. Note expanded scale in 1984 plot.